

5150-pixel CCD Linear Sensor (B/W)

Description

The ILX531A is a reduction type CCD linear sensor developed for high resolution copiers. This sensor reads A3-size documents at a density of 400 DPI, and A4-size documents at a density of 600 DPI at high speed.

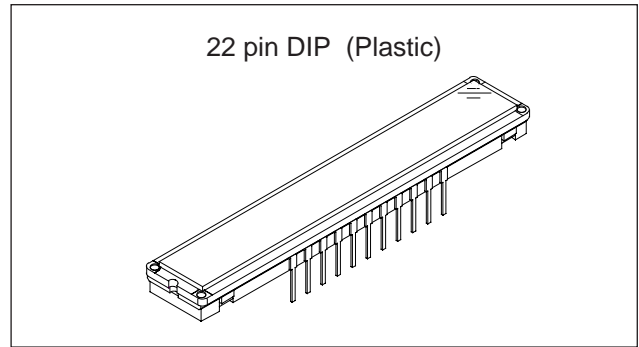
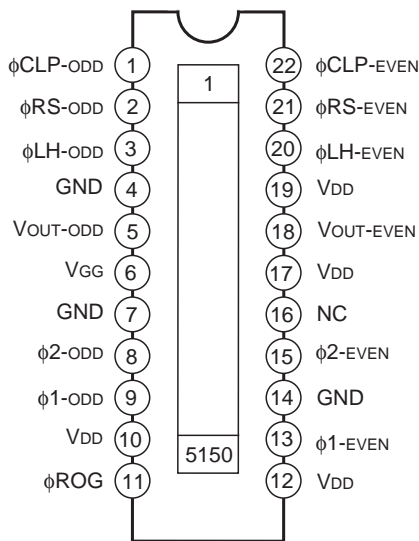
Features

- Number of effective pixels: 5150 pixels
- Pixel size: 7µm × 7µm (7µm pitch)
- Clamp circuit are on-chip
- Signal output phase of two-output simultaneous-output (alternate-output is available)
- Ultra high sensitivity/Ultra low lag
- Maximum data rate: 40MHz
- Single 12V power supply
- Input clock pulse: CMOS 5V drive
- Package: 22 pin Plastic DIP (400mil)

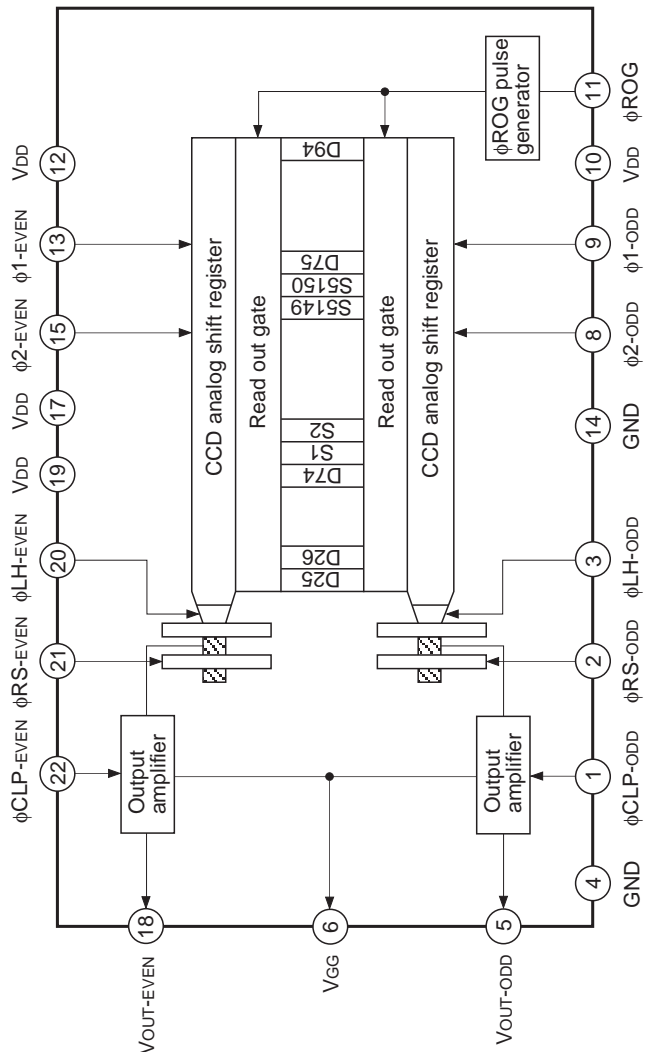
Absolute Maximum Ratings

- Supply voltage V<sub>DD</sub> 15 V
- Operating temperature -10 to +60 °C
- Storage temperature -30 to +80 °C

Pin Configuration (Top View)



Block Diagram



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### Pin Description

Pin No.	Symbol	Description	Pin No.	Symbol	Description
1	$\phi$ CLP-ODD	Clock pulse input (odd pixel)	12	V <sub>DD</sub>	12V power supply
2	$\phi$ RS-ODD	Clock pulse input (odd pixel)	13	$\phi$ 1-EVEN	Clock pulse input (even pixel)
3	$\phi$ LH-ODD	Clock pulse input (odd pixel)	14	GND	GND
4	GND	GND	15	$\phi$ 2-EVEN	Clock pulse input (even pixel)
5	V <sub>OUT</sub> -ODD	Signal out (odd pixel)	16	NC	NC
6	V <sub>GG</sub>	Output circuit gate bias	17	V <sub>DD</sub>	12V power supply
7	GND	GND	18	V <sub>OUT</sub> -EVEN	Signal out (even pixel)
8	$\phi$ 2-ODD	Clock pulse input (odd pixel)	19	V <sub>DD</sub>	12V power supply
9	$\phi$ 1-ODD	Clock pulse input (odd pixel)	20	$\phi$ LH-EVEN	Clock pulse input (even pixel)
10	V <sub>DD</sub>	12V power supply	21	$\phi$ RS-EVEN	Clock pulse input (even pixel)
11	$\phi$ ROG	Readout gate clock pulse input	22	$\phi$ CLP-EVEN	Clock pulse input (even pixel)

### Recommended Supply Voltage

Item	Min.	Typ.	Max.	Unit
V <sub>DD</sub>	11.4	12	12.6	V

### Clock Characteristics

Item	Symbol	Min.	Typ.	Max.	Unit
Input capacity of $\phi$ 1*1, $\phi$ 2*1	C $\phi$ 1, C $\phi$ 2	—	400	—	pF
Input capacity of $\phi$ LH*1	C $\phi$ LH	—	10	—	pF
Input capacity of $\phi$ RS*1	C $\phi$ RS	—	10	—	pF
Input capacity of $\phi$ CLP*1	C $\phi$ CLP	—	10	—	pF
Input capacity of $\phi$ ROG	C $\phi$ ROG	—	10	—	pF

\*1 It indicates that  $\phi$ 1-ODD,  $\phi$ 1-EVEN as  $\phi$ 1,  $\phi$ 2-ODD,  $\phi$ 2-EVEN as  $\phi$ 2,  $\phi$ LH-ODD,  $\phi$ LH-EVEN as  $\phi$ LH,  $\phi$ RS-ODD,  $\phi$ RS-EVEN as  $\phi$ RS,  $\phi$ CLP-ODD,  $\phi$ CLP-EVEN as  $\phi$ CLP.

### Clock Frequency

Item	Symbol	Min.	Typ.	Max.	Unit
$\phi$ 1, $\phi$ 2, $\phi$ LH, $\phi$ RS, $\phi$ CLP	f $\phi$ 1, f $\phi$ 2, f $\phi$ LH, f $\phi$ RS, f $\phi$ CLP	—	1	20	MHz
Data rate	f $\phi$ R	—	2	40	MHz

### Input Clock Pulse Voltage Condition

Item	Min.	Typ.	Max.	Unit	
$\phi$ 1, $\phi$ 2, $\phi$ LH, $\phi$ RS, $\phi$ CLP, $\phi$ ROG pulse voltage	High level	4.75	5.0	5.25	V
	Low level	—	0	0.1	V

**Electrooptical Characteristics (Note 1)**

(Ta = 25°C, V<sub>DD</sub> = 12V, f<sub>φR</sub> = 2MHz, Input clock = 5Vp-p,  
Light source = 3200K, IR cut filter CM-500S (t = 1.0mm))

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
Sensitivity1	R1	8.2	11	13.8	V/(lx · s)	Note 2
Sensitivity2	R2	—	25.1	—	V/(lx · s)	Note 3
Sensitivity nonuniformity	PRNU	—	4	10	%	Note 4
Saturation output voltage	V <sub>SAT</sub>	1.8	2.5	—	V	Note 5
Saturation exposure	SE	0.13	0.23	—	lx · s	Note 6
Register imbalance	RI	—	1	7	%	Note 7
Dark voltage average	V <sub>DRK</sub>	—	0.3	2.0	mV	Note 8
Dark signal nonuniformity	DSNU	—	0.6	5.0	mV	Note 9
Image lag	IL	—	0.02	—	%	Note 10
Supply current	I <sub>VDD</sub>	—	30	60	mA	—
Total transfer efficiency	TTE	92	98	—	%	—
Output impedance	Z <sub>o</sub>	—	150	—	Ω	—
Offset level	V <sub>OS</sub>	—	6.5	—	V	Note 11

**Notes**

- In accordance with the given electrooptical characteristics, the even black level is defined as the average value of D6, D8, to D24. The odd black level is defined as the average value of D5, D7, to D23.
- For the sensitivity test light is applied with a uniform intensity of illumination.
- W lamp (2854K)
- PRNU is defined as indicated below. Ray incidence conditions are the same as for Note 2.

$$V_{OUT} = 500\text{mV (Typ.)}$$

$$\text{PRNU} = \frac{(V_{MAX} - V_{MIN}) / 2}{V_{AVE}} \times 100 [\%]$$

Where the 5150 pixels are divided into blocks of even and odd pixels, respectively. The maximum output of each block is set to V<sub>MAX</sub>, the minimum output to V<sub>MIN</sub> and the average output to V<sub>AVE</sub>.

- Use below the minimum value of the saturation output voltage.
- Saturation exposure is defined as follows. SE = V<sub>SAT</sub>/R1
- RI is defined as indicated below. V<sub>OUT</sub> = 500mV (Typ.)

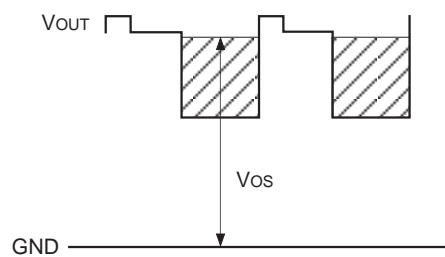
$$\text{RI} = \frac{|V_{ODD-AVE} - V_{EVEN-AVE}|}{\left(\frac{V_{ODD-AVE} + V_{EVEN-AVE}}{2}\right)} \times 100 [\%]$$

Where average of odd pixels output is set to V<sub>ODD-AVE</sub>, even pixels to V<sub>EVEN-AVE</sub>.

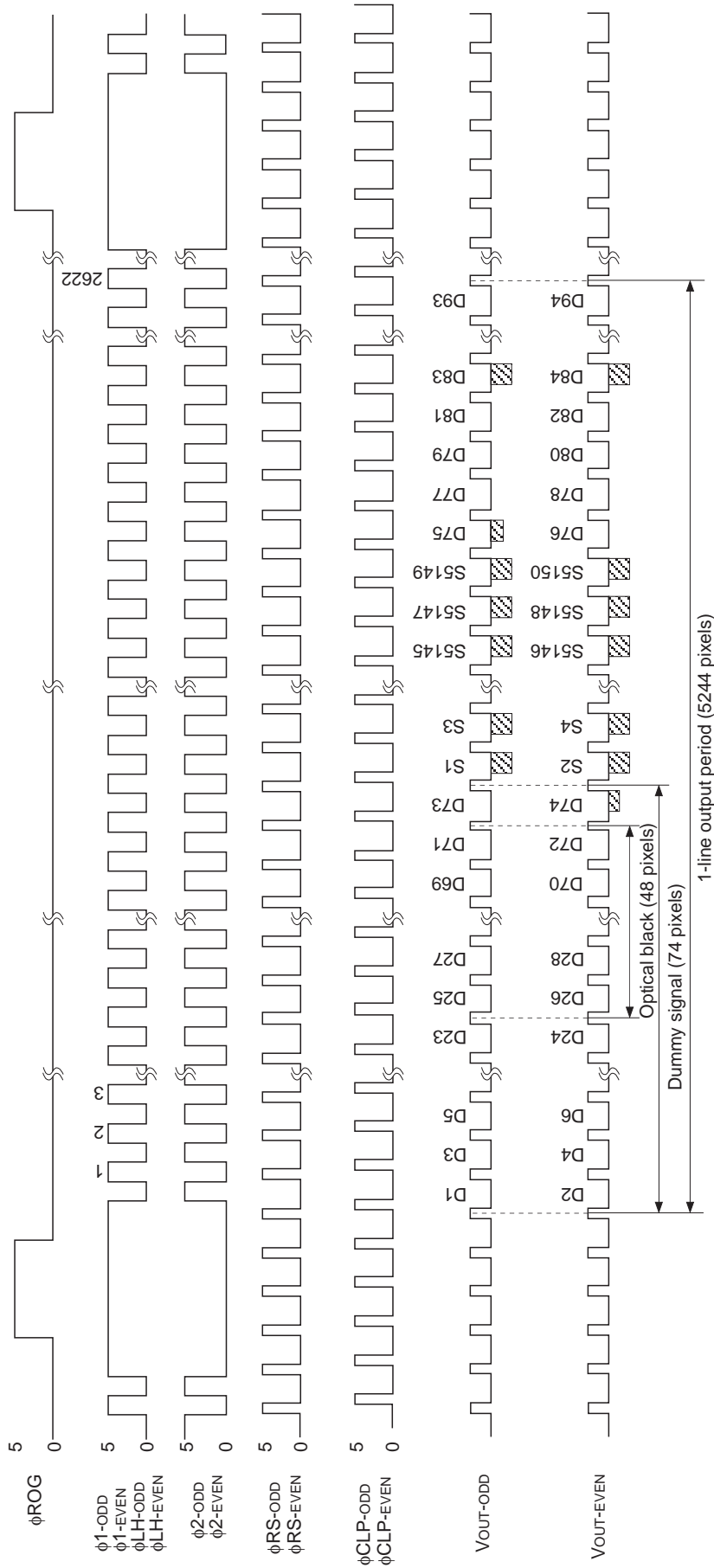
- Optical signal accumulated time τ int stands at 10ms.
- The difference between the maximum and average values of the dark output voltage is calculated for even and odd respectively. The larger value is defined as the dark signal nonuniformity. Optical signal accumulated time τ int stands at 10ms.

10)  $V_{OUT} = 500 \text{ mV}$  (Typ.)

11)  $V_{os}$  is defined as indicated bellow.

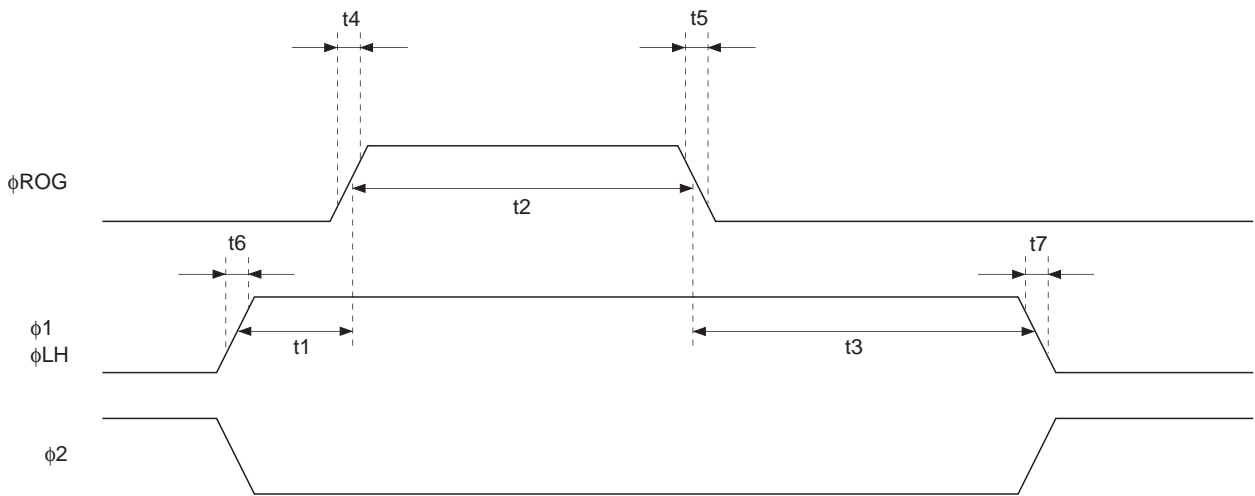


**Clock Timing Chart 1 (simultaneous output)**

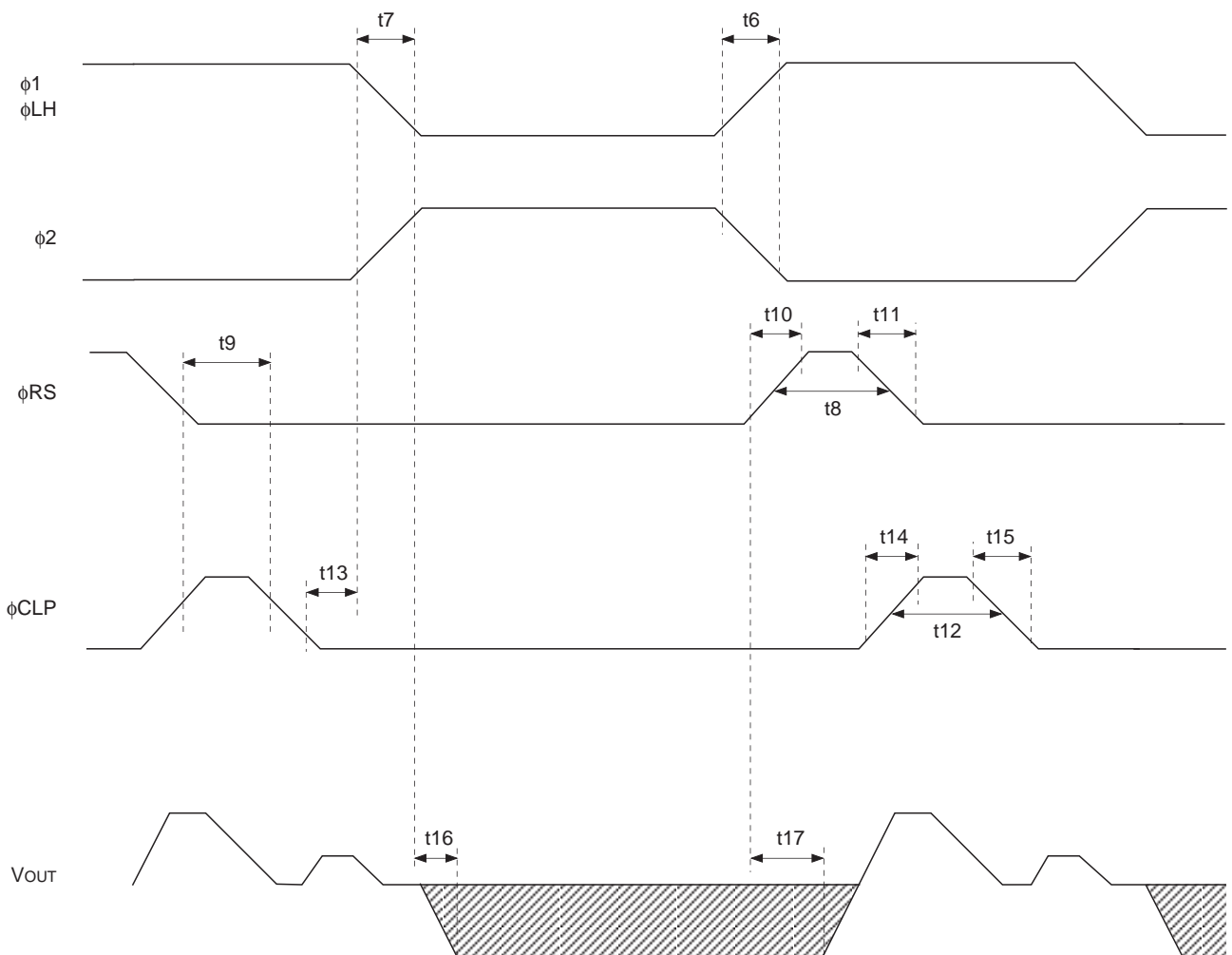


**Note)** The transfer pulses ( $\phi 1$ ,  $\phi 2$ ,  $\phi$  LH) must have more than 2622 cycles.

**Clock Timing Chart 2**



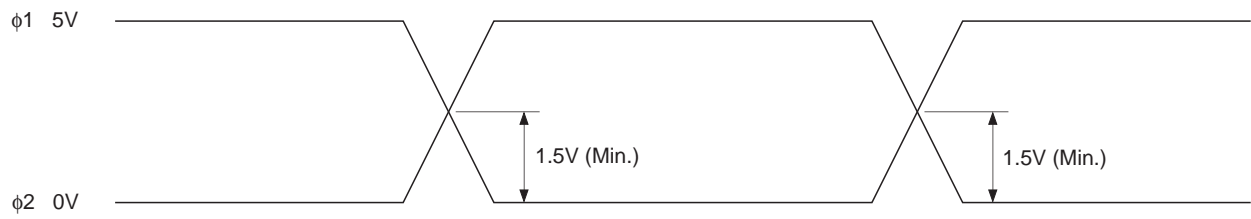
**Clock Timing Chart 3**



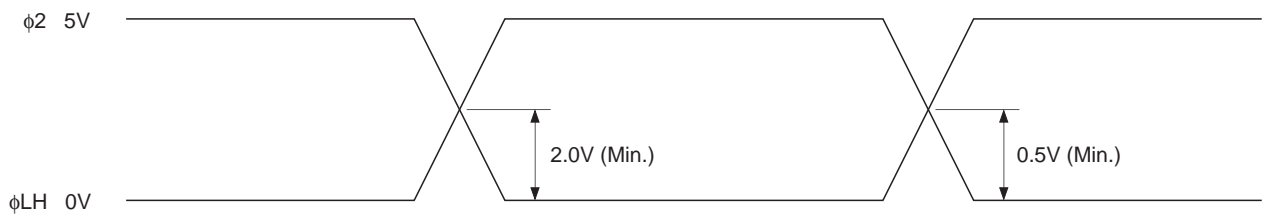
Clock timing of  $\phi_1$ ,  $\phi_2$ ,  $\phi_{LH}$ ,  $\phi_{RS}$ ,  $\phi_{CLP}$  and  $V_{out}$  at odd or even are the same as timing chart 3 in the case of alternate output.

**Clock Timing Chart 4**

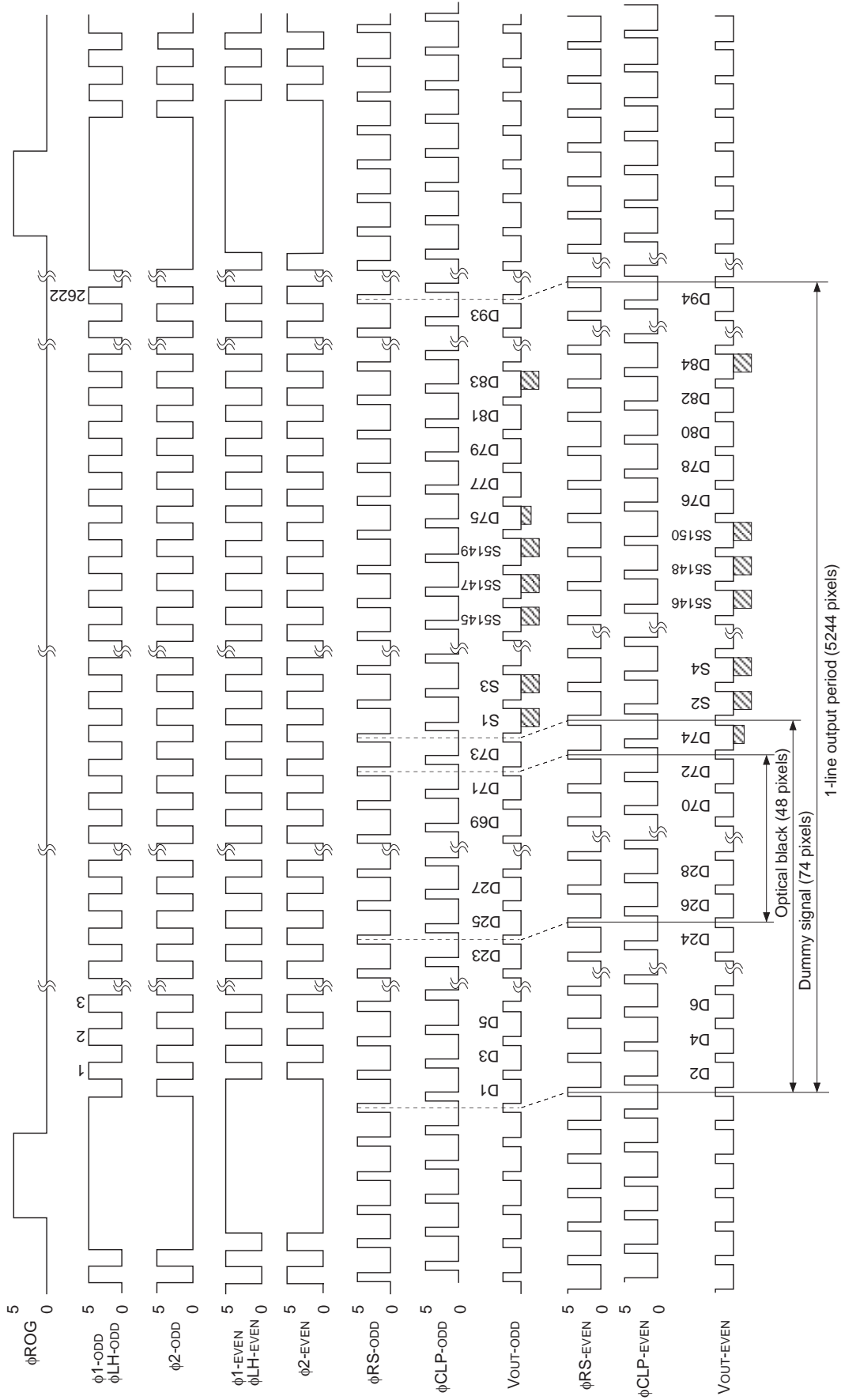
Cross point  $\phi 1$  and  $\phi 2$



Cross point  $\phi LH$  and  $\phi 2$



Clock Timing Chart 5 (alternate output\*)



**Note** The transfer pulses ( $\phi_1$ ,  $\phi_2$ ,  $\phi_{LH}$ ) must have more than 2622 cycles.  
 \* Alternate output is available by making  $\phi_{1-EVEN}$ ,  $\phi_{2-EVEN}$ ,  $\phi_{LH-EVEN}$ ,  $\phi_{RS-EVEN}$ ,  $\phi_{CLP-EVEN}$  delayed to  $\phi_{1-ODD}$ ,  $\phi_{2-ODD}$ ,  $\phi_{LH-ODD}$ ,  $\phi_{RS-ODD}$ ,  $\phi_{CLP-ODD}$  for half a cycle.

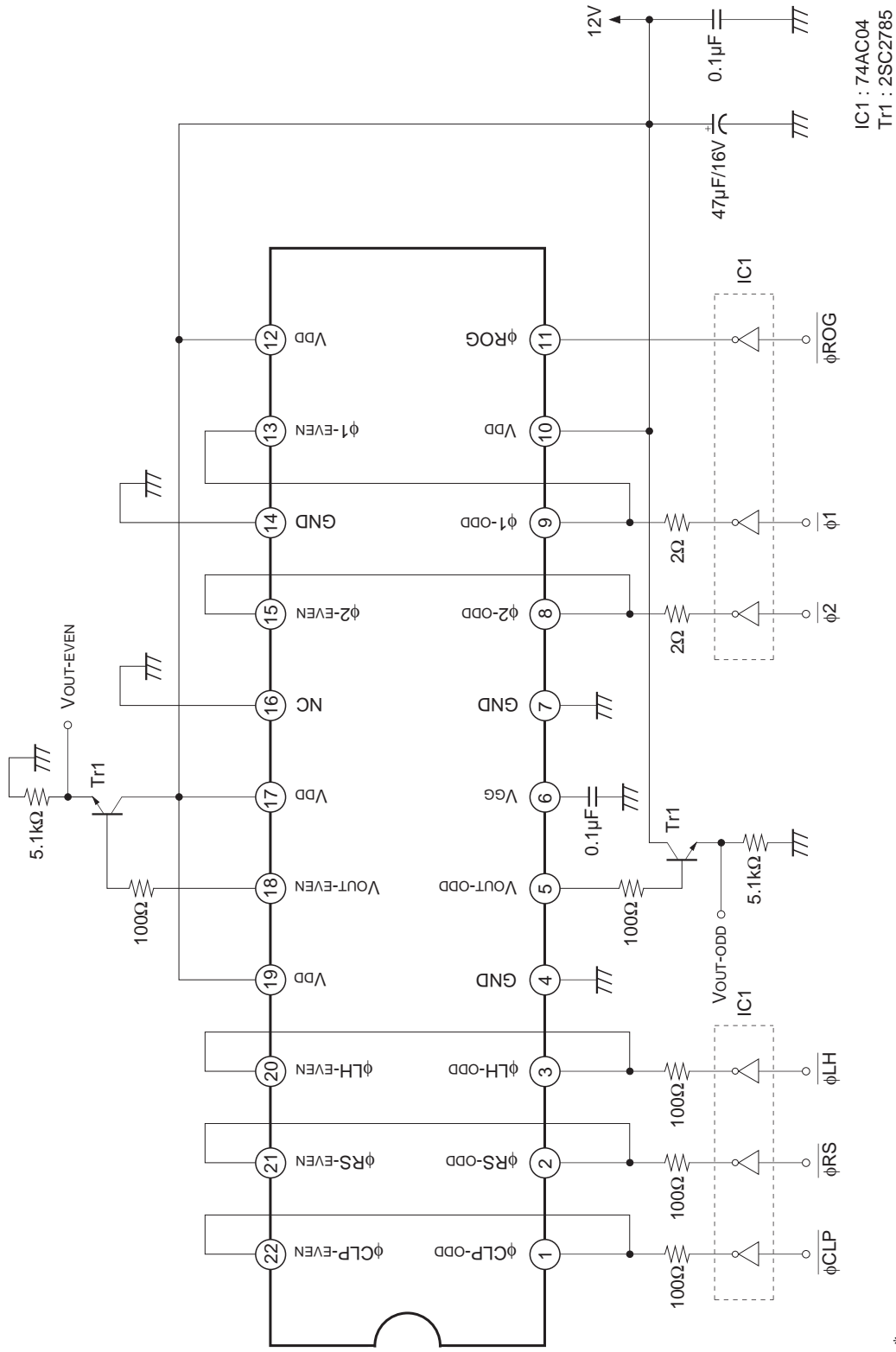


## Clock Pulse Recommended Timing

Item	Symbol	Min.	Typ.	Max.	Unit
$\phi$ ROG, $\phi$ 1 pulse timing	t1	50	100	—	ns
$\phi$ ROG pulse high level period	t2	600	1000	—	ns
$\phi$ ROG, $\phi$ 1 pulse timing	t3	400	1000	—	ns
$\phi$ ROG pulse rise time	t4	0	5	10	ns
$\phi$ ROG pulse fall time	t5	0	5	10	ns
$\phi$ 1 pulse rise time/ $\phi$ 2 pulse fall time	t6	0	20	60	ns
$\phi$ 1 pulse fall time/ $\phi$ 2 pulse rise time	t7	0	20	60	ns
$\phi$ RS pulse high level period	t8	10	200 <sup>*1</sup>	—	ns
$\phi$ RS, $\phi$ CLP pulse timing	t9	10	200 <sup>*1</sup>	—	ns
$\phi$ RS pulse rise time	t10	0	10	30	ns
$\phi$ RS pulse fall time	t11	0	10	30	ns
$\phi$ CLP pulse high level period	t12	10	200 <sup>*1</sup>	—	ns
$\phi$ CLP, $\phi$ LH pulse timing	t13	5	50 <sup>*1</sup>	—	ns
$\phi$ CLP pulse rise time	t14	0	10	30	ns
$\phi$ CLP pulse fall time	t15	0	10	30	ns
Signal output delay time	t16	—	8	—	ns
	t17	—	15	—	ns

\*1 These timing is the recommended condition under  $f\phi 1 = 1\text{MHz}$ .

Application Circuit \* (simultaneous output)

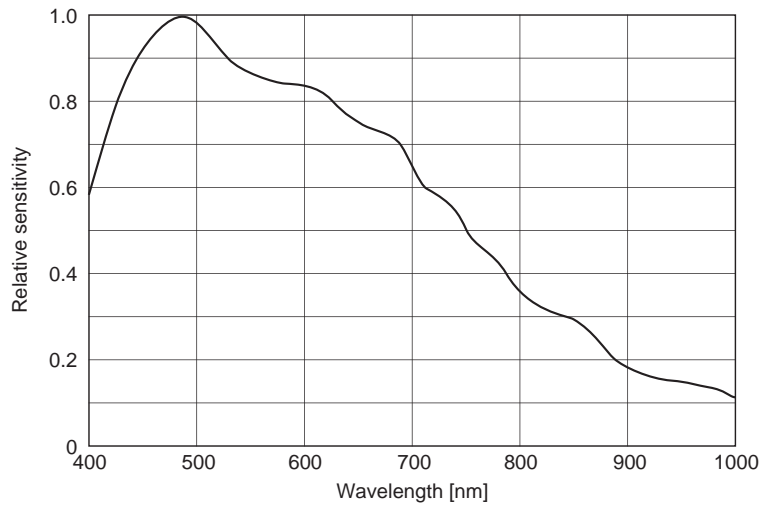


\* Data rate  $f_{\phi R} = 2\text{MHz}$ .

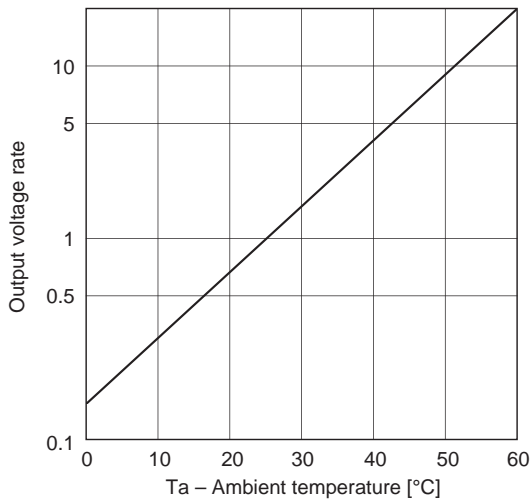
Application circuits shown are typical examples illustrating the operation of the devices. Sony cannot assume responsibility for any problems arising out of the use of these circuits or for any infringement of third party patent and other right due to same.

Example of Representative Characteristics

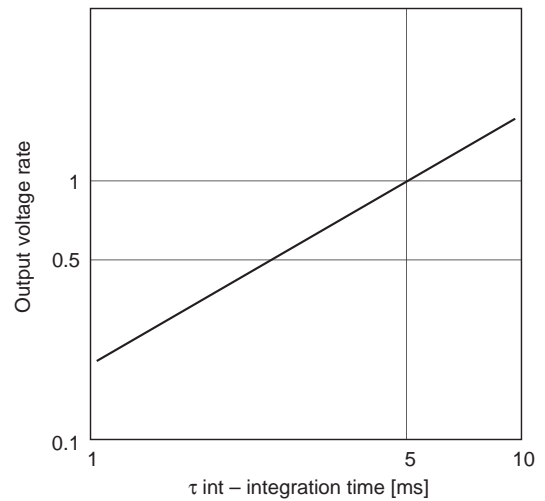
Spectral sensitivity characteristics (Standard characteristics)



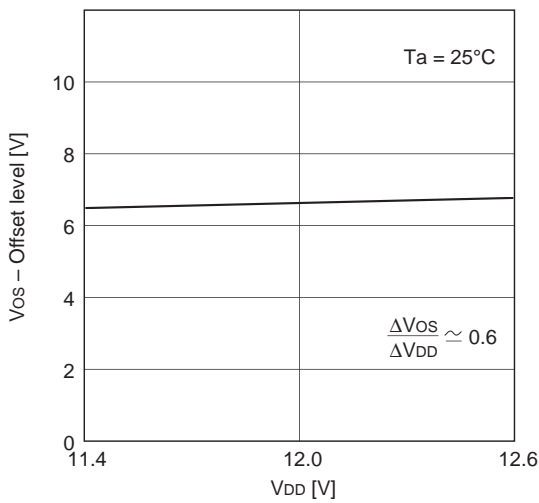
Dark signal output temperature characteristics (Standard characteristics)



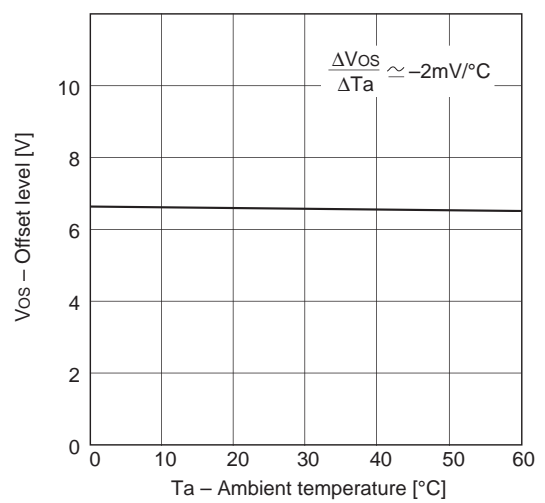
Integration time output voltage characteristics (Standard characteristics)



Offset level vs. VDD characteristics (Standard characteristics)



Offset level vs. Temperature characteristics (Standard characteristics)



## Notes of Handling

### 1) Static charge prevention

CCD image sensors are easily damaged by static discharge. Before handling be sure to take the following protective measures.

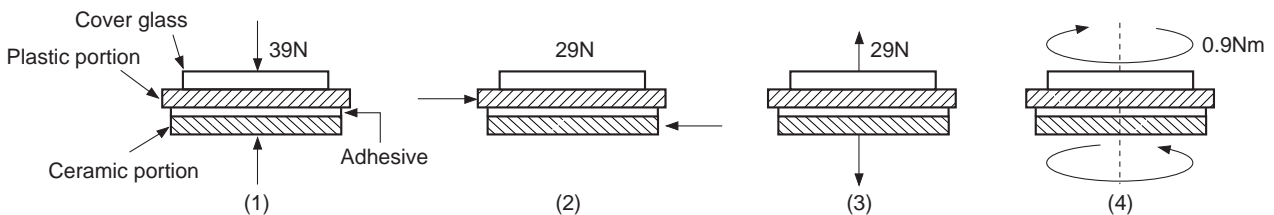
- Either handle bare handed or use non chargeable gloves, clothes or material. Also use conductive shoes.
- When handling directly use an earth band.
- Install a conductive mat on the floor or working table to prevent the generation of static electricity.
- Ionized air is recommended for discharge when handling CCD image sensor.
- For the shipment of mounted substrates, use boxes treated for prevention of static charges.

### 2) Notes on Handling CCD Packages

The following points should be observed when handling and installing packages.

a) Remain within the following limits when applying static load to the package:

- Compressive strength: 39N/surface (Do not apply load more than 0.7mm inside the outer perimeter of the glass portion.)
- Shearing strength: 29N/surface
- Tensile strength: 29N/surface
- Torsional strength: 0.9Nm



b) In addition, if a load is applied to the entire surface by a hard component, bending stress may be generated and the package may fracture, etc., depending on the flatness of the ceramic portion. Therefore, for installation, either use an elastic load, such as a spring plate, or an adhesive.

c) Be aware that any of the following can cause the package to crack or dust to be generated.

- Applying repetitive bending stress to the external leads.
- Applying heat to the external leads for an extended period of time with soldering iron.
- Rapid cooling or heating.
- Prying the plastic portion and ceramic portion away at a support point of the adhesive layer.
- Applying the metal a crash or a rub against the plastic portion.

Note that the preceding notes should also be observed when removing a component from a board after it has already been soldered.

d) The notch of the plastic portion is used for directional index, and that can not be used for reference of fixing. In addition, the cover glass and seal resin may overlap with the notch or ceramic may overlap with the notch of the plastic portion.

- 3) Soldering
  - a) Make sure the package temperature does not exceed 80°C.
  - b) Solder dipping in a mounting furnace causes damage to the glass and other defects. Use a grounded 30W soldering iron and solder each pin in less than 2 seconds. For repairs and remount, cool sufficiently.
  - c) To dismount an imaging device, do not use a solder suction equipment. When using an electric desoldering tool, ground the controller. For the control system, use a zero cross type.
  
- 4) Dust and dirt protection
  - a) Operate in clean environments.
  - b) Do not either touch glass plates by hand or have any object come in contact with glass surfaces. Should dirt stick to a glass surface, blow it off with an air blower. (For dirt stuck through static electricity ionized air is recommended.)
  - c) Clean with a cotton bud and ethyl alcohol if the glass surface is grease stained. Be careful not to scratch the glass.
  - d) Keep in a case to protect from dust and dirt. To prevent dew condensation, preheat or precool when moving to a room with great temperature differences.
  
- 5) Exposure to high temperatures or humidity will affect the characteristics. Accordingly avoid storage or usage in such conditions.
  
- 6) CCD image sensors are precise optical equipment that should not be subject to mechanical shocks.



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